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Processed: 2026-06-06
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Journal of the
INTERPLANETARY
EXPLORATION
SOCIETY
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VOL. 1
NO. 3
DECEMBER 1961
PRICE $1.25

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AN EDITORIAL ASIDE

The winds of war-and the winds of change-are apparently to be with us for still some time. Nevertheless it is more than likely that, in our time, we will see resolved, for once and for all and without recourse to "final" action, the present conflict between two schools of thought which neither brinkmanship nor diplomacy as this is understood in these days has so far resolved. We may then cease to think of other centuries and other times when, for more years than we care to remember (weapons of destruction were still in their infancy, after all) dedicated men and less dedicated men fought other dedicated men and less dedicated men in order that Truth, as each understood it, should prevail. Somebody has said that this is the history of the Western peoples since the days, as the late Dr. Ananda Coomaraswamy used to put it, when they turned down the wrong road. It is interesting to speculate on what would have happened if internal differences had not helped to drive the Moors out of Spain, if the Borgias had come to power in a Church whose influence was limited to the Italian peninsula, if a monk named Luther had turned to other paths, and if Vienna had become the capital

of a Muslim state. Apart from the fact that to speculate on this is less inflammatory than to wonder aloud about what might have happened in the mid-1860's, it does no harm and it may be somewhat chastening to realize that the thin hair breadth of success has sometimes altered history, and will undoubtedly do so again.

These days, however, we are faced by a far different problem. It is not only a question of conflict between two schools of thought-it is a conflict between two ways of life-between the shadows and the sunlight. Nobody denies that much remains to be done before we may, objectively, consider ourselves to be more than a grouping of peoples with a common language and kindred traditions. This should not blind us, however, to the moral sickness (if may use an old fashioned term) of those who live in and rule the shadows. Objective intellectual admiration for the achievements in science of those with whom we differ, should not blind us to the cost of these achievements in terms of blood and in terms of denial of those rights which we hold dear. We cannot shut our eyes and pretend that these achievements do not exist-these times do not allow us the luxury of ostrichism-but we cannot at the same time ignore the reality that from Kapitsa to Gagarin these achievements have come about because in their society the individual is nothing-the state, the demands of the state if you wish, is everything. It is this which fascinates some for whom what both we and they so erroneously call the communist way of life has a certain attractiveness-not doctrinally but because here is to be seen the ultimate refinement of the concept of the state first elaborated upon (in our culture) by Machiavelli, and then by Caesare Borgia, and then by Mussolini, and

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INTERPLANETARY EXPLORATION
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PLORATION SOCIETY, Vol 1, No. 3. Published
quarterly by the Interplanetary Exploration Society,
37 Wall Street, New York 5, and edited by Hans
Stefan Santesson. Single copy price $1.25; Sub-
scription $5. for 4 issues. Office of the Editor-
489 Fifth Avenue, New York 17. Copyright, (C), 1961,
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Non-Cuvierian Cataclysms

by Ivan T. Sanderson, B.A. (Cantab), F.L.S.

If there is one single expression, nay rather a single word, that will send any and every geomorphologist and geologist screaming for their hills, it is cataclysm. This is exceedingly odd; but the reasons for their positively hysterical behaviour in face of this bogey may, nonetheless, perhaps be fairly easy to assess. Somewhat amusingly, moreover, other sciences, and common-sense, which still occasionally raises its ugly head, not to mention just plain facts, have now forced these gentry into a position where they are going to have to face cataclysms and literally swallow them, and in massive doses. They are not going to like it but they still get their best salaries from oil companies.

Before proceeding, we had better define the areas of knowledge within which our discussion is to be prosecuted. There is considerable misunderstanding about this, mostly of a semantic nature, even among the specialists concerned. All the "sciences" are of course interlocked, and their

respective technologies are becoming increasingly so. Nevertheless, some classification of knowledge is still valid and called for. Among the so-called "natural sciences" all manner of classifications have been suggested, based on various criteria. Many are legitimate and feasible; others definitely are not. The best, in my opinion, is the simplest, and is circular. It starts with the only precise but least circumstantial exercise, namely mathematics and, after passing through the whole gamut of knowledge ends up just about where it started in the outer limbo of metaphysical philosophy. By this process we move steadily from the general to the particular and back again; starting with the mathematical background of nucleonics, proceeding to physics, chemistry, biology and so forth; and coming full circle with geology, planetology, astronomy, and cosmology.

To simplify grossly, you may study The Whole, the Cosmos (i.e. the detectable Universe), our solar system, our Earth, life-forms on this earth, their behaviour, and thus proceed to an enquiry into the exercise and potentialities of Mind. Beyond that you will find yourself engrossed in what is loosely and quite erroneously called metaphysics and will inevitably end up in the contemplation of the meaning of meaning or, once again, The Whole. In this circle or cycle it is manifest that the study of this planet or Earth as we call it, forms a very clear-cut unit. Everybody agrees on this but almost everybody disagrees on what to call it. Recently, there has been a tendency by those calling themselves Geomorphologists (i.e. those who study the shape or form of the earth) to absorb the Geologists, a term which means simply the study of the earth. All manner of other persons are thus left in limbo, such as climatologists, palaeoclimatologists, oceanographers, geographers, meteorologists, glaciologists, metallurgists, crystallographers, podologists, petrologists, mineralogists, hydrologists, and so on and on. It is manifest however that all specialists are studying either one or other aspect of this planet and we would therefore humbly suggest that the whole lot should be classed in the overall as Geologists.

However, to geology may be attached a large number of strings, for no science can be in any way totally independent of any other. Geologists are almost wholly in the hands of zoologists and botanists in several respects, in those of chemists in others, and most particularly in those of planetologists and astronomers, for this earth is but a

planet hitched to a minor star. And it is when we come to examine the strings attached to geology by these latter that we run into trouble and where the geologists start running. The real bone of contention is the time factor.

Let us now review the attitude of geologists currently, and the reasons for these. Geology, and especially those aspects of it which concern themselves with the surface rocks of the earth's land surface is a comparatively new science. Two hundred years ago it was a mess. Religious beliefs then current limited the past life of the earth in a prodigious manner; beliefs that culminated less than a hundred years ago in a solemn pronouncement that the whole shooting-match was only 4004 years old. Fossils were peremptorily dismissed as either sports of nature or tricks placed in rocks by the Almighty to test our faith in certain aspects of mythical Biblical history. Then came one Charles Lyell.

Lyell was a Scot and utterly pragmatic. He was a working geologist -- a sort of super rock-hound for pay -- and he disregarded both religious dogma and evolutionary theory, and instead went straight to the core of the then problem, developing not so much a theory but a dogma of his own that may be lightly summarized as Gradualism. This stated simply that

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everything on the surface of the earth is just as it has always been, and always was just as it is. Changes there have been, still are, and always will be, but nothing not seen today is needed to account for them. Following the line that a million monkeys strapped to a million typewriters for a million years would eventually write everything that Shakespeare is alleged to have written, he opined that such forces as vulcanicity, weather, tides, gravity, as seen in operation today are quite sufficient to wear away continents and fill oceans and raise new continents and dig new oceans. In other words, we need no special creations, deluges, or any other "cataclysms" such as religious philosophers and other geologists like the palaeontologist the Baron Cuvier demanded. All that is needed is sufficient time.

The geologists let out a concerted whoop of joy and got to work writing textbooks at high speed. Nothing is more obvious, they said, than the obvious, and with every sign of humility for having until then failed to appreciate this fact, they set to

work on their individual problems, one and all absolutely assured that the Principles of Geology (Sir [AD] Charles Lyell, 12 editions, from 1830-1876) were not only established but final. They, and to a great extent the geomorphologists still think so; hence their screaming meemies when the mere word cataclysm is so much as mentioned.

Curiously, they are in a fog on two counts. First as we shall see, they are now faced with incontrovertible evidence of just that on every hand and in all ages: second, they don't know the meaning of the word itself, immediately and invariably jumping to the conclusion that it implies a universal deluge such as was envisaged by the mighty but extinct Baron Cuvier. Meantime their (the petrological or "rock" geologists) colleagues, the palaeoclimatologists, with such men as C.E.P. Brooks in the lead, and the radiocarbon daters, and the sub-oceanic coreborers, and the seismologists, and all sorts of other people began turning up all manner of enigmas that just could not be explained on gradualistic lines. Even the archaeologists got into the act, demanding to know how up to fifty feet of unstratified sediment could have been deposited hither and yon over vast areas by any gradual deposition. But orthodoxy has become completely entrenched in the field of surface geology and geologists will go to any lengths of paralogica to explain or explain away these unwanted observations.

And this brings us to a monumental paradox the so-called Ice Age that was set-up by geologists themselves but which has come to plague them unmercifully until today it has become frankly untenable. They first set it up as what may be called a "gradual cataclysm" but they never could explain even that or give valid reasons for it. Now, the damned thing has had to be speeded up to a point where it is not only not gradual in any way but is cataclysmic. Further, while geologists themselves demonstrated that this phenomenon as originally conceived for the recent Pleistocene period was multiple, having to be divided into four major phases each with numerous sub-phases, it became apparent that there had been many other "ice-ages" extending back in time to the earliest point definable by the examination of the earth's surface rocks. What is more, these evidences of earlier glaciation turned up in the most awkward places, like the tropical areas of South America, Africa, and the Orient. This posed several very difficult questions. First, if the equatorial regions should be covered with ice, the temperate and polar regions must, from

a purely astronomical point of view, have been even colder; and, since neither plant nor animal life can exist on an ice-cap, all life would have to have been eliminated all over the earth. However, this manifestly has never happened during the past half billion years at any rate, for the record left in the rocks in the form of fossils displays a complete continuity; yet, during this period, parts of the equatorial regions have several times been glaciated. This fact therefore necessitated the parts outside the tropics being warmer in order to support life; but this is impossible. Therefore some alternative had to be proposed.

The most obvious was to suggest that the axis of spin of the earth had from time to time changed, so that regions that now lie in the tropics constituted the poles. To this the engineers immediately objected, pointing out that the earth is nothing but a vast flywheel perfectly "lubricated" and if you shift the axis of spin of flywheel, you will set up a wobble, and the whole thing will immediately fly apart, and even with explosive force. At the same time, both they and the astronomers wanted to know what force might be available sufficiently strong to cause such a shift, even if the earth be regarded as a gyroscope, the direction of the axis of which can be altered.

At this point it was ingeniously suggested that the tilt of the earth's axis to the plane upon which it revolves around the sun might have changed and have lain over to such an extent that it pointed directly away from the sun. In this case one hemisphere would experience perpetual sunlight, the other perpetual darkness and thus extreme cold. During the shifts to such a situation and back again any and every part of the globe could be glaciated. Such a condition would bring about the virtual boiling of one pole and a massive freezing of the other but possibly might permit life to carry on, especially in water, around the twilight zone -- i.e. around the equator. But this time the geomorphorphologists as well as the astronomers, and even many geologists put forward the most strenuous objections, the astronomers demanding to know what force or forces could cause such a shift or shifts, and the others pointing out that such shifts would have caused such an upheaval and imbalance that the results would have been just as catastrophic as a shift in the axis itself, while the geologists stated flatly that they could not find any evidence of anything like this having ever happened. This put everybody right back where they had started.

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The next logical step-- and it was a most logical was the floating continents idea, as propounded most notably by Wegener. To simplify this theory let us point out that, at the time of its formulation, it was believed that the continents were permanent rafts of lighter rocks, their roots going down into the next layer as deeply as their uplands

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and mountain ranges stuck up into the sky, and that they literally floated on the next layer down. It was further believed that the oceans were floored with the upper surface of this next layer. Wegener cut out the outlines of the continents, together with their continental shelves as found today under shallow fringing coastal seas, from a globe, and then fitted them all together like a giant jigsaw puzzle; and, admittedly, they fitted very well. He therefore put forward the idea that they had once all formed parts of one great continent covering a little more than a quarter of the earth's surface and had then split up, and the parts drifted around until they had reached positions around the globe that gave it fair stability. During these meanderings any part of all the parts could have drifted under a pole and experienced a glacial period.
This was a good idea and at first sight seemed both possible and even logical. [This did not prevent it from being roundly condemned from the outset but over the years it gained some considerable measure of acceptance.] Yet, objections were raised and some of these appeared to have been valid; in contrast to the overall condemnation, for which reasons were not given. However, time seems to have bolstered the objectors, for later and current studies of the floors of the oceans now prosecuted down to considerable depths have brought to light the fact that they are composed of the same lighter rocks as the continents though forming a much thinner layer. At the same time, sampling of the sediments sometimes of considerable depth themselves that overlie these rocks it appears that the oceans have been just as permanent as the continents, as oceans, at least during the critical immediately past half a billion years. This means that, not only have their bottoms or floors never been above water-level, but also that no continents have ever "floated" over them.
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At this point there open up two paths that we may

follow and, although one is the logical one to take, I propose to investigate the other first for special reasons. First, it leads us into a cul-de-sac; but, second, it is in that dead-end that we shall eventually find ourselves at the end of our journey! This may sound like a contradiction, and it is.

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There appears to be only one alternative to Wegener's theory of continental drift. This is a theory first put forward a few years ago by Hapgood and Campbell in a book entitled "Earth's Shifting Crust", which title is almost fully explanatory in itself. It is, simply stated, that the whole skin of the earth continental rafts and the thin floors of the oceans together from time to time comes partially unstuck from the next layer down, to an extent which permits it to shift as a whole on the major body of the earth within. The reasons for these occurrences are technical and valid but must be summed up by saying that, whereas mountain ranges, however vast, eventually and fairly rapidly geologically speaking come into what is called iso-static balance, large icecaps that are piled up on top of land do not, so that unless they lie directly over the poles, they cause an imbalance in the spin of the earth. The effect of the present Antartic icecap is, as pointed out by Hapgood, equivalent to a washing machine with a single clot of laundry jammed on one side; and it was just this happen-stance th that author's cellár 'that started him thinking on this subject, for the machine tore itself out of the floor and rolled across the room, pinning him to a corner and nearly killing him! The en-gineer, Campbell, worked out the eccentric forces produced by the present Antarctic icecap being as off-center as it is, and demonstrated mathemati-cally that the pressure resulting on the equatorial belt (such forces are transferred at right angles over the surface of a spinning globe) are already very great and are cumulative. Further, they are rapidly reaching a point at which, pressure being equivalent to heat, they will start to melt the basaltic layer of rocks next below the surface skin. Once that happens the whole skin will start to "come unstuck", and the terrible pressures that have built up will be transformed first into motion of the skin. To visualize the result, think of an orange with a darning needle made of nothing stuck through its middle, and revolving as does the earth around its non-tangible axis. Then, imagine the skin to become loosened from the main body of the fruit within.

That main body will continue to spin as before but if the skin has a large bump on it, it will start to swivel with a view to getting that bump up to the equator, due to certain basic principles of dynamics. If the skin has come permanently unstuck, and the bump is made of rock and eventually achieves this objective; then, the whole orange will be unstable because, instead of spinning round smoothly, it will • start to go "kerr-chump, kerr-chump, kerr-chump" as any garage man can tell you a car wheel will do if it is even a tiny bit heavier at one point around its rim. And this in time might cause the whole thing to fly apart. It has been suggested that this is what happened to the planet that once circulated between Mars and Saturn, which came unstuck and blew up, causing the asteroid belt.] If, on the other hand, the bump is ice, it will melt long before it gets there.

There is nothing wrong with this theory from a logical or mechanical point of view; there is a great deal of circumstantial evidence that it could produce the results observed, and that it has done so; and nobody yet has been able to bring one single valid argument against it. The only objection put forward was by those who believe in what is called "fossil magnetism" which initially purported to systematize the various ways in which magnetic particles are aligned in the various surface rocks of the earth. Unfortunately for those contentions, however, it has now been shown that the magnetic lines that wander about the earth's surface change so drastically and SO fast that such magnetized particles could point in any direction during as little as a single millenium of deposition; while, almost every parcel of every strata - both horizontally and vertically has at one time or more been moved around and reoriented by earth movements, overfolding, and so forth. Even comparatively recent strata have been upended, overfolded; and, over areas great and small, have flowed, so that, even if all the magnetized particles in them were originally laid down in alignment they might now be

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pointing every which way. Any arguments based on this notion put forward to discount the Hapgood-Campbell theory are therefore quite invalid.

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Apart from them, however, nobody has as yet put forward any other argument against the theory. Yet, it was nevertheless universally condemned and,

initially at least, also buried. Later, however, the Geotimes official periodical of the Geophysical Union re-reviewed the work and concluded by saying "so, perhaps we ought to dust off our copy of 'Earth's Shifting Crust', and reread it." To date, however, this promising suggestion constitutes a theoretical cul-de-sac, and one which geologists appear to be unwilling even to explore.

Meantime, they are meandering up the other path, encountering all manner of road-blocks, some genuine and some almost ridiculous, and expending enormous energy in removing them, while the great basic problems of their science continue to lie untouched and remain just as enigmatic as ever, like vast and endless morasses all around them. It is not only the matter of ice-ages that remains unexplained but also the other great questions such as what really causes mountain-building, and where did the strata go that were laid down between the end of the Cretaceous period and the beginning of the Palaeocene. Details of geomorphology and of surface geology, as well as incredible refinements in seismology and related fields keep accumulating, but these basic questions remain unanswered and to a large extent unasked though these road-block-type theories are from time to time erected. What is more, a number of them, although pretty roundly refuted long ago, still appear in the textbooks and enlightened popular works by professional scientists.

Fundamental to all others is the matter of the nature of the creation of this planet. The old idea was that it started out as a fiery ball, either ripped off the sun, or at the same time as the creation of the sun and other planets. Some time ago, Weizsacher in Germany and Kuiper in Chicago put forward an almost exactly contrary idea, namely that while sun and planets were formed together, the latter arose from the drawing together of a sort of monstrous cosmic gravel all at ultimate cold, from which it followed that the earth, instead of having gradually cooled and shrunk, has been gradually heating up and growing due to heat generated by radioactivity which is distributed throughout its body and the absorption of radiation from without and by the acquisition of material from meteorites and meteoritic dust. It is manifest that these two opposing procedures would have quite different effects on the present conformation of the earth and its past history but what we actually observe neither confirms nor negates either.

Some things in the earth's past history do appear

to be undeniable: one is that mountains do grow; another is that there have been some marked world-wide discontinuities during which (and for very long periods of time) either no strata were deposited or after which all that were laid down were washed away. The third observation has for some time been highly popular among geologists but may be a mis-conception. This is that these events, and the inci-dence of so-called ice-ages, occur periodically and rhythmically. By this notion, the earth lies virtually dormant for long periods (up to hundreds of millions of years) during which it warms up till palms and salamanders can grow at the poles, and all moun-tains are eroded down to rolling plains country and all shallow seas are filled with sediments. Then, the theory goes, something (periodically) upsets these idyllic conditions; the whole planet is con-vulsed; volcanoes spout and the surface rocks are shifted about and pushed up into great mountain ranges; while, the whole begins to freeze up so that vast icecaps spread down to the temperate lati-tudes. This whole notion is quite impossible as we shall see in a minute but its proponents made various bold suggestions as to its cause.

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These may be divided into two groups terrestrial and the astronomical. Seeking a cause of the first type, Urey among others suggested that the internal temperature of the earth slowly built up due to heat released in the process of radioactive decay. Most of the ideas of the second type center around the suggestion that our sun may be a long-term variable which for some inexplicable (and un-acceptable to astronomers, I might add) reason, from time to time suddenly puts out less radiation than normally. No such stars are known, and any such behaviour runs counter to everything dis-covered about the nature and history of stars. The alternative namely, that the sun from time to time puts out more energy for brief periods is somewhat more feasible, and there are, of course, stars known that do this on various time scales. In this case it is conjectured that such increased radiation could sufficiently alter our upper atmosphere as to cause a blanketing effect against heat from out-side but not the dissipation of heat from inside, so that the atmosphere cooled down sufficiently to bring on the snow and ice.

I know of no serious contention with Urey's initial suggestion except that there is no direct evidence for it, while heat thus generated should be

continuously transferred outwards from the center to the surface of the earth and thus radiated into the atmosphere and on into space. Also, even if this should be the cause of any real long term periodicity in geological history, it still in no way obviates one absolutely fundamental feature of our earth's surface -- a feature that must always be inherent in any globe revolving round a sun to some extent, whatever angle its axis makes to the plane of its travel around that sun. This is, simply, the polar caps. If the axis of our earth were perpendicular to the plane of its rotation round the sun, considerable circular areas about both poles would be in a perpetual state of dusk, varying from sunset to almost total darkness during each day. We have already seen the conditions that would pertain if the axis were horizontal to the plane. Anything in between (such as at the present time when it is at an angle of 23-1/2 degrees) results in various degrees of annual fluctuation between day-long sunlight and day-long darkness.
In all circumstances, from the vertical position to an angle of 45 degrees, there will be two polar regions receiving from no direct sunlight at all to

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only half a year of any; while from 45 degrees to the horizontal, one or other whole hemisphere will receive increasingly less and less, the other more and throughout the year. In every case, either both or one polar region will be much colder than the rest of the earth's surface and, unless the equatorial temperature reaches the boiling point will in all circumstances be glaciated. What is more, apart from glaciation, the mere paucity of sunlight in those regions would not permit the growth there of the kinds of woody trees or the existence of such animals as corals in the seas and salamanders on land, all of which have been found in the fossil stage in the polar regions and to very high latitudes. Thus, there must always have been polar ice-rafts, ice-fields, and ice caps in the polar circles in other words, two "iceages" going on all the time! In all this we may actually ignore the matter of temperature for, as Brooks pointed out, the difference between "iceage" conditions and non-iceage, is probably not more than a few degrees. It is the amount of sunlight that matters, and not only for the presence or absence of plants and animals. We must further remember that (using

the centigrade scale from freezing of water at zero, to boiling at 100) taking the mean average overall annual temperature of the whole surface of the earth at 15 degrees C., it would take a drop of only that amount to freeze everything but, while it would need 85 degrees to boil all the water, a very much smaller increase in temperature would kill all land life.

There is no evidence of either event ever having taken place, while there is of an absolute continuity of life during the past half billion years. Further, if a mere increase of overall heat at the surface of the earth could give the polar regions temperatures equivalent to present equatorial ones, the seas in the latter would boil.

Thus, once again, we are back in the cul-de-sac. We still require explanations for two glaring facts. One is the presence of clear evidence of former glaciation in equatorial regions: the other is the presence of fossils of numerous kinds of plants and animals (not to mention coal beds which are chemically impossible of formation in polar regions) of temperate, subtropical and even equatorial types in strata far in and virtually all over the present polar regions. And, until these two facts are explained, the whole of geological history must remain on the most unsure ground.

If, moreover, the only tenable theory is that the whole earth's crust must from time to time shift, it would seem that geologists should drop everything until they can show that this is or is not possible, what causes the shifts, possible events during the shifts, and the end results of these. This has not been done nor has it even been suggested: to the contrary, any such enterprises have been condemned not only as being worthless but downright dangerous in that they might indicate consideration of a theory so "crackpot" as to be bordering on the insane. This attitude is basically a demonstration of hidebound concepts, lack of imagination, and pure lack of knowledge (especially of other sciences) on the part of the geologists but it is both fostered and made more militant on account of certain concommitants of the main theme. Principal among these are the mere suggestions of "cataclysms"; and the time factor.

It is possible that the orthodox might in time come to accept the idea of the earth's crust as a whole shifting, just as Wegener's notion that it shifted about in bits, though initially also buried, gained slow acceptance and quite a wide recognition by leading specialists. However, the speed at which

it might do so suggested by Hapgood and Campbell a matter of tens or even hundreds of thousands of years for the completion of a cycle, which is, geologically speaking, quite modest was considered outrageous. The notion that its triggering and initial phases could be initiated in not millenia, or even centuries, but in hours, is of course absolutely horrific to the orthodox. Yet, this is the very conclusion that an ever-increasing number of workers in all manner of diverse disciplines are being forced to consider.

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Space does not permit me even to list the wide range of such evidence for such, so that only one or two enlightening examples can be given. Before doing this, however, I am constrained to say that, in one respect, I can appreciate the attitude of the orthodox, for sudden cataclysms or catastrophes on a global or even continental scale have throughout the ages been a stock in trade of the mystics and the crackpots and, it has to be admitted, also of most ancient histories, folklore, and tradition, including the Bible! In recent years we have been submitted to an endless parade of such, like those of Velikovsky, Auchinchloss Brown, and others which could only too readily be shown to be founded on a welter of false premises, inaccurate information, and misinterpreted findings. Quite apart from these "Delugists" including Baron Cuvier -- there has been a positive torrent of "theories" about the earth being bombarded by meteors of vast size, rains of mountain-sized hunks of ice, lethal gases, space-fleets, and goodness knows what else. To plough through these is both great fun and most depressing for, although almost all of them seem to have one or two valid suggestions, their supporting evidence is either nil or grossly distorted, and all are bolstered with completely inaccurate beliefs about what is known in truly scientific fields.

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The kind of cataclysm that I am talking about, and which diverse sciences are now increasingly demanding, while of quite another nature, is every bit as wild-sounding (and even terrifying and sensational). The difference is that in this case we are dealing with observed facts that require explanation but for which none can be put forward on gradualistic grounds nor be explained by anything other than a cataclysm. Further, the suggestions that have been put forward to account for such occurrences, were propounded by competent scientists in several fields, and have nothing to do with ancient beliefs

however feasible they may be. Among these facts are such as the following.
It has been observed that in caves all over the Old World in which there are datable deposits, there was a sudden collapse of their roofs due apparently to a global earthquake. Then again, vast deposits of unstratified silts up to fifty feet in depth are

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found over enormous areas, all apparently of identical date, indicating mass floods. (This is not to be interpreted as meaning that there was a universal flood such as Cuvier favoured, but coincident floods of enormous extent over all lowlands below a certain altitude.) Thirdly, there is the enigma of mass bone beds in which countless billions of animals' remains are packed babies, immature, adults in the prime of life, and ancient ones all together
in such circumstances as positively to preclude their being the result of agelong slow accumulations of accidents such as drownings. Then, there is the perennial headache of the frozen mammoths and other animals of the Arctic muck that somehow got themselves frozen, either whole or literally torn apart in an absolutely fresh condition, so suddenly that even their stomach contents did not have time to decay, despite their considerable internal heat, while their skins did not slough off either. There are also troublesome and seemingly inexplicable geological items such as the bottom of the Grand Canyon gorge which is cut through extremely dense ancient rock and which must therefore have been cut through last and thus when the river was at its weakest (as a digging or abrading agent), and which is also a meandering gorge, something that is impossible if the river did have the cutting power to dig the gorge.
Each of these enigmas taken separately is open to all kinds of bizarre explanations but, taken together with dozens of others, and all apparently being amenable to correlation in time to a few very brief periods, and all seeming to call for tremendously widespread violences of sudden onset and short duration, they not only form a pattern but call for the occurrence of events that, however much one may abhor the word, can only be called cataclysms. Personally, I am not at all satisfied that a great number of other geological phenomena as are ob-

servable today can be explained on gradualist lines either. The overnight results of the 1954 Assam-Bhutan earthquake (observed by Kingdon Ward and described by him in the Journal of the Royal Geographical Society) were so astounding, that one looks at other mountains and I think particularly of those immediately to the south of Monterey in Mexico with the gravest misgivings. There is certainly nothing gradual about their denudation; in fact, denudation has hardly even got started, yet the things are thrust straight up into the air for thousands of feet with clean, new surfaces of fracture and on a monumental scale. If they had risen slowly, they would have been compensatingly denuded and eroded. Then again, basaltic lava flows that cover half a state can not have been gradually extruded: they solidify far too quickly and so would form a mountain over the vent up which they came.

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All these phenomena call for a time-scale so short as to be cataclysmic. We cannot go into the causes of any such sudden events nor even their possible side effects. We can however say that the shifting crust theory does provide acceptable and possible causes and could explain many if not all of the observed side effects. But, it is not the only possible set of suggestions as to the cause of some cataclysms. There is certainly one other possibility of a quite separate nature but which might, again in some cases, be the trigger that sets off shifts. This is an old chestnut and beloved of the crackpots but it has now cropped up in a most unexpected and highly orthodox domain. It appeared in this guise in an article by Robert S. Dietz, oceanographer of the Navy Electronics Laboratory in San Diego, California, in the August, 1961 issue of Scientific American, entitled "Astroblemes", a term first proposed by the author for meteorite craters found on the surface or in a "fossil" condition in the surface rocks of the earth. In this, the author points out that the number of these that have been discovered is being augmented rapidly, and he described new methods for identifying them in ancient strata. The core of his hypothesis is that the earth has been bombarded by the same number of meteorites throughout its history as has the moon (resulting in a more purely numerical hitting of the earth, due to its greater size) but that most have been obliterated on our planet because of the continuous processes of earth movement, erosion,

and so forth; while, the moon, having an inert surface, shows all its scars. Dr. Dietz then goes on to point out that, judging by the number of such craters on the moon, such-and-such numbers should have fallen on various areas of this planet. Then, he makes a most pertinent observation. Since only a little over a quarter of the surface of the earth is covered with land, some three quarters of these great meteorites should, by the mere law of averages, have landed in the sea. Now, the effects on the surface strata of rocks of a meteor of the size of that which hit Vredefort in South Africa aeons ago and which left such a circular effect 130 miles in diameter, can be most accurately calculated, and these can be backed up by experiments in miniature in a laboratory. Also, from this data the effects of one such landing in an ocean are precisely predictable. Dr. Dietz proceeds to give these latter in a few cold words more chilling than anything ever thought up by the crackpots. He observed that "a giant meteor falling in the middle of the (north) Atlantic would generate a wave 20,000 feet high" and then goes on to point out that this would not only rush over the entire eastern seaboard of North America but even top the Appalachians, and thus descend upon the lowlands of the center of this country. The number of such giant meteorites that should have hit the north Atlantic alone is, moreover, according to Dr. Dietz's estimate for the United States, somewhere in the neighbourhood of 200.

What better cataclysm does one need? And it is no good saying that all the big boys landed in the early days of the earth's history for the Barringer, Chubb, and Ghana craters are of comparatively very recent geological dates. No wonder the geologists run for the hills when even the word cataclysm is mentioned.

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PUBLICATION: JOURNAL OF THE INTERPLANETARY EXPLORATION SOCIETY
DATX j5/5(65q HOUHE x: *; (5 HE 9;
DATE: DECEMBER 1961, VOLUME 1, NUMBER 3, PRICE: $1.25
ARTICLE: NON-CUVIERIAN CATACLYSMS
AUTHOR: IVAN T. SANDERSON
PAGES: 2-7

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Journal of the
INTERPLANETARY

EXPLORATION
SOCIETY
ISAAC ASIMOV
WENZELL BROWN
V. CHEREDNICHENKO
LESTER DEL REY
GEORGE FIELDING ELIOT
IVAN T. SANDERSON
and
GRAZDIPPLE BONK
Translated and Illustrated
by HANNES BOK
VOL. 1
NO. 2
JULY 1961
PRICE $1.25

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AN EDITORIAL ASIDE

THE JOURNAL OF THE

the Russians in outer space (we'll have an article

Above and beyond the need for catching up with INTERPLANETARY EXPLORATION

on this matter of inner and outer space in our next issue) we need at the same time to consider, agonizedly or otherwise, the chances for survival of the society we know.

The time is past when we can tell ourselves, whistling as we pass the graveyard, that all is well and that it is a wonderful world.

It isn't.

It is a hungry world.

And it is a frightened world.

The price of mastery of forces whose potential we still do not understand has been fear of these same forces if unleashed and uncontrolled.

Living in the shadow of this fear, many have seen fit to surrender to a school of thought, Wagnerian in tone, which has attracted to its ranks many genuinely great spirits and still others the entirety of whose dedication to truth may be questioned.

I do not deny the need for watchfulness lest some Blimp on either side-press a button that can mean the beginning of the end to our dreams and to our hopes.

But I suggest that above and beyond this need for watchfulness we must prepare to face the days and the years to come with dignity and with an awareness of what the problems can be - and of what will he needed for survival!

This world which we ourselves will not see

but which our children and our children's children will call home this world will not be created by hysterical people, keening dark prophecies but it will be created and moulded by those among us, speculative thinkers. independent thinkers, possibly inconoclasts, undoubtedly mavericks, for whom Today is a challenge and for whom Tomorrow is a reality!
This publication is for such people!
If you have an inquiring mind if you have faith in Tomorrow and if you pay more than lip-service to the idea that we are on the treshold of New Frontiers you belong with us!
If so help us keep publishing!
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THE JOURNAL OF THE INTERPLANETARY EXPLORATION SOCIETY, Vol 1, No. 2. Published quarterly by the Interplanetary Exploration Society. 37 Wall Street, New York 5, and edited by Hans Stefan Santesson. Office of the Editor-489 Fifth Avenue, New York 17. No responsibility for unsolicited submissions can be assumed by either Editor or Publisher. Copyright, (C), 1961, by Interplanetary Exploration Society. Reproduction of contents in whole or in part, except for purposes of review, strictly forbidden.

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Space Hazards
by Ivan T. Sanderson

Flight out of the protective envelope of our atmosphere into what has now become known as space is going to be a most hazardous enterprise. All manner of new dangers, perils, and menaces, which are slightly different ways of saying challenges, are going to beset us, and literally on every side. However, I am not thinking of petty annoyances such as gravity which has to all intents already been overcome, or even the effects of radiation of a seemingly endless string of varieties, all of which we will have to investigate and then try to counteract. Let us not for a moment suppose that it is only these novel dangers that we will have to face, for all the old ones are going to be with us too.

The dangers of travel have mounted in geometrical proportion to man's development of methods of travel. Wandering about the surface of the earth on foot was hazardous enough but it became altogether more so when men took to riding animals, for immediately the effects of gravity, speed, and distance began to multiply. Sleds, chariots, carts, and other wheeled devices brought more woes, and when men started to go boating another whole series of potential accidents loomed. It may be proved statistically that it is today five times safer to fly than to drive an automobile but the hazards are actually multiplied many times. Those conservative folk who apply the old cliche. "I'd rather have one foot on the ground", are not really as stupid as some of us moderns with our minds filled with space-travel think. And space travel is really a deadly thing. Overcoming gravity is a costly and dangerous procedure but it is as nothing to the problems involved in having not to overcome it. And all the other hazards gathered up during the ages go with it, not excluding the most primitive one of all --namely, collision. But collision with what?

Space, by the very definition of the word, implies an emptiness or a place where there is nothing, and this is the way we have come to thing of everything outside our atmosphere. True, there are multifarous stars grouped in galaxies, a few planets going round each of these and some satellites revolv-

ing around those, but almost anyone ought to be able to avoid colliding with even the smallest of these. Then, there are a large number of smaller bodies called the Asteroids that roar round and round our sun on a fixed orbit between the planets Mars and Jupiter. Some of these are the size of small moons, others not much bigger than a modest house, but they are accompanied by a vast host of lesser chunks, and by a whole stream of solid material so particulated that it may be referred to as cosmic dust. Flying -- or should we say "boating" or "driving" through this region of Inner Space would obviously seem to call for the exercise of extreme caution. But compared to space itself all these astronomical bodies amount to almost nothing. Mathematically, all of them, including even the asteroids, amount to just about one rock the size of a football lying on one of all the roads in the United States. They may, therefore, be more or less ignored. Other things can not.

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We now know that space is not at all empty. Astronomers are constantly pointing out to us that there are vast clouds of dust, gas, and free ions drifting about all over the universe in between the larger solid bodies, and it is now even being mooted that all space may form a sort of attenuated gas. Matter in vacuo tends to draw together in knots because of the basic precepts of gravitional attraction. Thus, if there is even a tiny bit of "gas" thoughout space, it will tend to gather in "clouds", and these will in turn tend to further concentrate so that by reciprocal and tangential gravitic attractions, they will usually start whirling. This is possibly the manner in which new concentrations of matter are born that, in time, give rise to galaxies and within these, solar or plantary systems. Solid objects in space are of various kinds. Most of them appear to be now attached to or even more probably, intrinsic parts of planetary systema. That not all of them are so, however, I will point out in a moment. These objects vary in size greatly and, apart from suns and planets on one hand and gas on the other, they range in size from small

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moons to very fine specks of dust. The existence of almost all of these types has been known since the dawn of history, but their true nature and their overall volume I can hardly say number has only been properly appreciated within the last century. Various names have been given to some of them, according to the manner in which they have been observed either from this earth or upon this earth. As a child I was greatly puzzled by these things In this. I am sure that I was not alone. In fact. I believe that we all are so when we first hear about them and more especially when and if we see any of them for ourselves. Our confusion becomes the worse confounded the more of them we see and the greater variety we encounter. These things are what our elders and betters have chosen to call Comets, Meteors, and Meteorites. As I say, these things have been known since most ancient times but the ideas held about them by even our parents were odd to say the least, while their grandparents held quite other views; and, before their time, the whole business was regarded in still another light. It is, perhaps, because of this constant changing of opinion as to the nature of these things, that we all start out in a great muddle about them. Each of us appears to go through the whole atavistic sequence of our ancestors, starting with wonder.
pure
At first sight there appears to be no connection between the three. Comets are marvellous astronomical items distant. aloof, silent, mysterious. and in many respects terrifying. Meteors are almost personal in their clarity, apparent proximity, and startling prevalence. Meteorites, on the other hand, are almost mythical things with a dour and mystical quality. One hardly believes in comets unless one sees one; meteorites we hardly ever see. and if we do, they don't look very impressive, so that we may well ask what all the fuss is about and who ever said that there was anything worthwhile about them. Meteors, on the other hand, are almost commonplace to all of us. All you have to do is go sit or lie out in the open on a clear night and observe them streaking through the night sky. And this, apparently was the way in which the men of the stone ages regarded them. But then certain facts became apparent.
--
or

treme cases
--
ness even greater than that of the full moon in the
tropics, and they may make a terrific noise. In ex-
or if, by chance, you are in the
right place they may be seen to explode with a
wall-shattering detonation. Such phenomena, rare as
they are, could not be ignored even by most prim-
itive men. These things came down out of the sky,
made a tremendous light, and sometimes let-off a
tremendous noise. This was startling enough; but
then, some of them were seen to disintegrate and
give rise to lesser light which fell to earth with a
noticeable wallop. And to cap the business, people
in due course found the ground churned up where
those bits had landed, and either great stones or
hunks of metal at the points of contact. This put
an entirely new light on the whole busines.
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In very ancient times the world must have ap-
peared to be a pretty orderly place. Days succeeded
nights, and the seasons at least in the temperate.
sub-polar and polar belts progressed regularly
and steadily. Apart from birds and other flying crea-
tures, heavy things stayed put on the ground; only
cobwebs, small dead leaves, and such light objects
went up, and then only in a wind; fogs and ones
breath alone seemed to be able to reverse the gen-
eral process. What is more, the sky above looked
very solid. By day it formed a blue dome in front
of which the clouds sailed along like smoke in a
wigwam; by night it looked like a solid black tent
either studded with lights or pierced by small holes
through which light streamed. The natural thing was
to think of the universe as a hemisphere with us
standing on the level floor, and the sun, moon, and
the clouds wandering about in the dome above but
periodically, and in due course, going down over the
edge and dropping through into whatever lay out-
side the dome or hemisphere. And that "outside"
came to be regarded, and not illogically, as another
"world" or universe in which other people (gods,
for instance) lived. Thus, when bits of iron, which
was not known on the surface of the earth in those
days and let us never forget this --landed from
on high, it was presumed that somebody had drop-
ped or thrown them through one of the holes that
you could see in the dome at night.
--
For this reason, anything that fell from the sky,
There are also things sometimes seen in the sky apart from a dead bird, was regarded with very
called Bolides. These look at first like meteors

"Shooting Stars" as they are more popularly called --but, instead of just flashing on and off and leaving a faint green streak far above, they persist for some appreciable time and leave a huge flaming trail right across the sky. Also, they may appear to (or actually do) come down. In some cases they are so bright that they light up the whole earth to a bright- considerable reverence by our remoter ancestors. And not only by them, for in the Bible you will find it recorded (Acts, xix, 35), that at Ephesus they not only worshipped Diana but also "The Thing that fell from the Sky." Similar "things", all of which appear to have been or are known to have been meteorites, have been found in Mayan temples, and other places of worship throughout the

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world, while there was a similar object in the oracular cave at Delphi, and the "Black Stone of Kaba", which is preserved in the very holiest sanctuary of the Muslim world today, is also of this nature. The metal iron itself was, indeed, for mil- from the Gods on high.
lenia regarded as a product of the sky and a gift
These facts alone were enough to impress our ancestors, and they are enough to promote all manner of atavistic beliefs in each of us when we first hear of these things. They also explain why meteors, their giant cousins and bolides, and especially their end-produces, the meteorites, should have continued to hold a position of the utmost esteem in all religions, even the Christian. Had they not done so, we might still, like the Academie Francaise of a hundred years ago, be disregarding them or even denying their true nature. The very idea that any thing, and least of all a stone, could fall from the sky was abhorrent to elementary science, and the very fact that the deeply "religious" asserted that they did so went far toward convincing the early scientists that the whole thing was no more than an old wives' tale. It was a Bishop-of Zagreb, in what is now Yugoslavia-who really saved the day by not only preserving a meteorite that fell in Hraschina but also a most detailed series of reports on interviews with all eye-witnesses, and sending them on to the Emperor of Austria. Upon this material a German physicist by the anme of Chladni based his theory that such objects had come from space enough to penetrate our atmosphere without burn- and were only the residue of shooting-stars large

ing up through friction and being completely vaporized. Nobody believed him until the year 1803 when a whole "shower" of stones fell near Paris and was observed by so many that even the pompous Academicians admitted that such things could and did take place. From then on, there was a new approach to the matter of both meteors and meteorites. Their connection with Comets came later.

Meteors are, as all of us know, tiny greenish streaks of light that illumine our night skies for a brief second. You can see them on almost any night but careful observation long ago disclosed a number of most interesting facts about them. First, there are invariably about twice as many in the second half of the night as in the first; secondly, there are also twice as many in the period July to January as there are between January and July; thirdly, while they come all the time at an average of about thirteen a night in the first period and seven per night in the later, (as seen from any one point), there are certain times of the year when they come in vast swarms. These swarms have been given

names of which the best known is that of the Leonids, which show up every October and November. These swarms are named from the nearest star in the quarter of the heavens from which they appear to spout. Thus, there are also the Perseids in August, the Lyrids in April, the Andromedes in November, the Aquarids in May, and the Orionids in Oct. ober. Whatever causes meteors, they come both singly or in swarms or clumps.

The fact that many of these swarms come round and round on time, or more or less on time perennially, further shows that they follow a definite orbit around the Sun. In other words, they are part and of our solar system. What is more, the majority of the swarms manifestly travel around the same way that we do in that we encounter more of them as our side of the earth turns towards the sun in the early hours. Also, calculations have shown that the "speed" at which they enter our atmosphere varies from 7 miles per second to 45 miles per second which is just right if we are to catch up with some and run head-on into others.

But there are also erratics, as well as the swarms, and these seem to come at us from all angles and at all times. Actually, it has been estimated that at least some seventy-five million large enough to be seen by the naked eye enter our atmosphere daily of which at least one is big enough to reach the surface of the earth as a meteorite. Almost count-

less millions, perhaps billions, more that can be seen only in telescopes also come in; and then there are still more that are beyond the resolution of even our best close-range devices. These things are solid and all those that fail to reach the surface of the earth vaporize. The aggregate is not much cosmically speaking but still, added up over the years, it amounts to a very considerable amount of new matter being added to this, our paltry planet.

Then there are other things that have apparently come down out of the sky in absolutely uncountable billions. These are called "spherules"--little pea-sized metallic objects that are scattered all over the ocean floors. None has ever heen found on land and this must mean that some factors have caused their rapid deterioration thereupon. It also suggests that they are no longer falling; otherwise, we would either see them doing so or find them on the land surface. The volume of these spherules is, in the aggregate, very vast. It has been estimated that the earth acquires about a ton of matter per day from meteors but that any of them smaller than a watermelon is completely vaporized so that its residue is in the form of gas. The total volume of the spherules estimated to lie on the ocean floor, however, runs into the billions of tons.

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Since meteors incandesce, it is possible to analyze them spectroscopically. It has been found that they contain iron, calcium, manganese, magnesium, chromium, silicon, nickel, aluminum, sodium, and lesser traces of a long list of other elements, in that order. The "showers" have invariably shown a strong calcium line which is typical of what we call "stone meteorites. It thus seems quite sure that meteorites are indeed nothing but large meteor cores; or, putting it the other way around, meteors are simply the visible results of glowing gases produced by the entry of solid bodies into our atmosphere--both the vaporizing material of those bodies themselves and the molecules of the air superheated by friction duc to their passage. The brightest are those erratic wanderers that come at us from "outer space". rather than from orbits around the sun, and which may have extremely high velocities.

Before coming to enquire into the nature of these bodies that thus variously enter our atmosphere we must mention another aspect of meteors that is of great significance. This is their apparent connection with Comets. Comets are altogether mysterious en-

tities. They too are quite numerous, and much more so than is customarily supposed. They have also been known since most ancient times, and they too fall into two distinct classes.

There appear to be some 100.000 planetismals in our solar system. All but a very few of these are concentrated in what we call the asteroid belt. These are single solid bodies that may be detected only by the light they reflect. There are, however, in addition some 120.000 other objects also going around our sun but on elliptical orbits and around planes other than that of the planets and asteroids. These appear to be composite entities made up of clusters. large or small. of variously assorted solid pieces. These show up as comets as they approach the sun when they emit light (of themelves) and develop what have been called "tails". Actually. these are not tails but streamers that point away from the sun. which grow in size as the comet goes towards the sun, and diminish again as it leaves its presence, often breaking off in hits like the intermittent trail of a jet plane These entities that periodically become comets travel enormously variable distances in lozenge-shaned circuits around the sun. One. Encke's Comet, takes only three and a half vears to make the round trip; others have been calculated from the curve' they make as they come by, to take as long as a million years Then there is the other kind of comet. These are erratics that just seem to appear from anywhere and which may be captured by our sun or which it is believed (due to the hyperbolic form of their course) go around two larger bodies at more or less fixed distances apart, one at, each end of their circuit.

Since the "head" of a comet does not show as a dark mass when seen against the orb of the sun it is assumed that the little pieces of which it is formed must be only a few feet in diameter and not too closely packed. It seems that, as the comet approaches the sun. atomic particles are, to put it crudely. "sucked out" by the greater body but lose velocity rapidly so that the comet-head catches up with them and they bend backwards. flow past its sides. and stream out behind to form the "tail". This matter is in a state of high excitation and actually glows; at the same time it is dense enough also to reflect sunlight. The eviction of these atomic particles constitutes a sort of continuous explosion to sunward.

The majority of the comets go around the sun in roughly the opposite direction to that of the planets This is rather puzzling but may be explained if it

is presumed that most of them originated from the same particular event that gave rise to the meteorites, and perhaps also the asteroid belt--namely, the disintegration of a planet of about the size of earth--for. hits from such an explosion would take off in all directions but most would go backwards as it were. However, it has not by any means been decided what the origin of the comets might be. There is. nevertheless, one phenomenon that points to their common origin with meteors and thus with meteorites: and there is now a very considerable body of evidence to support the idea that all of them that belong to our solar system--ie which are not erratics-are parts of such a planet that blew up. and not too long ago at that. This is a peculiar affai
The simple fact is that the meteor showers all seem to be associated with comets. There is an almost precise correlation between the Leonids and Temple's Comet; between the Perseids and Tuttle's; the Lyrids and a comet known as 1861 No.I: and the Andromedes with Biela's. More significant still is that the Aquarids of May, and the Orionids of Octoher coincide with the orbit of Halley's Comet which intersects that of the Earth at two points--as it goes towards and away from the Sun. Further Biela's Comet divided into two some years ago and then disappeared entirely but the Andromedes continue to appear on time every time we pass through that comet's old orbit. From this it seems that meteors are strung out all along the orbits of the comets but come in clumps along that orbit: and this would seem to indicate most strongly that meteors and comet-heads are the same kind of bodies. Since meteorites are but fallen meteor-heads, we may as-

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sume that all three are one and the same in basic substance.
The most interesting aspect of the whole business is therefore the presence of what at least appear to be "Wanderers" among those spatial bodies, for, as we shall now see, all those bits of them that have liness of construction and contents within rather been examined in the hand, show a surprising order-specific limits. They all look as if they originated in a single body. If this was a planet of our solar sys-But, if some of the pieces we have examined are tem that blew up, everything would be quite feasible. long to our solar system, we have to assume that erratics or wanderers and did not originate in or be-

other planetary bodies have blown up all over the place, and that they all had very much the same constitution--and not only in gross proportions of elements but more especially in isotopic proportions. This is a very startling thought for cosmologists, and one for them to worry about. Our concern is with the nature and extent of hazards to space-flight, and running into a "wanderer" would be no less disastrous than catching up with a piece of one of our own comets on its ordered passage through our inner space.

The chance of collision with solid objects in space is, really, extremely high. In fact, both statistically, and by the simple nature of things space collisions will not be amenable to classification as accidents; they will be a mathematical certainty, and on a pretty close time scale. Not only astrophysicists, astronomers. and cosmologists, but even Actuaries, some figures. Most significant is that collisions of have already asked this question and come up with some kind will be continuous and universal, but that they will increase in potential (destructiveness) at a blessedly slow rate. Further, there is a strong suggestion that the increase itself is rather rapidly diminishing, has been doing so for some hundreds of thousands of years, and is progressive. This is the translation into simple terms.

sort of language beloved of statisticians and needs First, it is now manifest that the whole of space is filled with light photons and other radiation that must be passed through by anything venturing into it. Next, there is now known to be a great deal of what is called dust in space, ranging from individual molecules of light gases to particles large enough to be seen by the naked eye. These, in turn, merge imperceptibly into a class of larger items that ranges all the way up to planetismals. So far we do not know if the size of all these things forms a smooth curve on a graph or whether certain sizes are commoner than others or whether some sizes may be missing altogether. From the evidence of

meteors and the little oceanic bed spherules it would seem that there are no such gaps in the series but that, at the same time, their occurrence, (i.e. their number) diminishes inversely in direct proportion to their size.

Critical point for size, viz-a-viz collision with a space-ship, naturally depends or will depend upon many factors, such as the strength of the material of which the ship is made, its and the space items' velocity, and so forth; and this is really the crux

of the whole matter, for the number of bits and pieces of say, the size of a pea that are wandering about in or tearing through our particular sector of this galaxy appears to be very great. If several billion such pieces enter the atmosphere of our very minor planet twenty-four hours. and the earth bores a tunnel through space that is only some four thousand miles wide, there must be an awful lot of this-sized material. A space-ship only fifty feet in beam, on a trip to Mars, would be peppered by them.

The other feature of these calculations is one that at first sounds encouraging It is simply that the number of all solid items in space around our part of the universe appears to have been diminishing rapidly. This is frightfully interesting but unfortunately even if it is so, it is only so on a cosmic scale. There is a great deal of evidence to show that many more meteorites fell on the earth in pre-historic times, and that more comets. meteor-showers, and meteorites were seen even in pre-Christian times than now. The theory is that the explosion which gave birth to all of them was not really so long ago, and that the Earth and the other planets have been "sweeping" the remains out of the sky at a good clip ever since; gathering in first the biggest, such as those that left the numerous craters on the moon and the big craters identifiable on earth-and eliminating the smaller progressively in proportion to their numbers and thus their size. This is all very pleasant but the few years or even months between the time of writing this and getting our first space-ships off the earth is not going to show any worthwhile decrease in their overall numbers.

While collision and radiation, especially if continuous, may be so deadly it may hold up our whole space exploration program for years. centuries, or millenia, or might even negate it altogether, striking or being struck by even very small particles that are travelling at astronomic speeds may be almost as final. A bee, going along at only sixty miles an hour will make a hole in the windshield of a racing car doing 150 m.p.h., if they meet head on. Spaceships travelling at 20.000 m.p.h. relative speed.

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and meeting pea-sized bits of nickel-iron travelling at 45 miles per second actual speed, or 54,000 m.p.h., are going to experience very alarming events. If the ships are made of aluminum or magnesium sheeting

like airplanes, they will, of course, just be shot full of holes but if they are heavily enough armoured to prevent this, something almost equally unpleasant will happen. To understand this we must turn once more to the matter of meteorites.

Since the initiation of the science of meteoritics which was subsequent to the fatal fall near Paris in 1803, careful records have been kept of what are called both "falls" and "finds". The former are meteorites that have been located as a result of having been observed actually falling; the latter are those found on or in the ground and which are identified solely by their composition. So far about 1500 of both kinds have been recovered in this period from all over the world. They range in size from pieces of bolides that have exploded and which are no larger than grains of wheat, to a fall in Arkansas weighing 880 pounds; a find in West Greenland (which is now in New York) weighing 79,000 pounds; and another in Southwest Africa, that still lies in situ, that weighs 66 tons. The largest known stone meteorite was found on Long Island and weighed 1230 pounds in the aggregate.

These are the largest individual meteorites or pieces of meteorites so far found, but it is manifest that very much greater ones have landed on earth. Some of these have been meteoritic showers such as the group that landed in the Sikhataalin Mountains of Eastern Siberia, north of Vladivostok, at 10:35 on the morning of the 12th of February, 1947. This was apparently a large meteorite, calculated originally to have weighed about a thousand tons and to have been thirty feet in diameter. that broke up in our atmosphere and then showered down, making over 100 holes, some of them 75 feet across and down to 400 feet in depth. This, however, was even initially very small in comparison to some bodies that have hit this earth.

That such events took place was not acknowledged until after the first World War though evidence of such had been observed as early as the year 1890 when the famous crater near Flagstaff in Arizona was discovered. Over this there was heated and continuous debate until 1920. because geologists had stated first, that it was of volcanic origin, and then, in the absence of any volcanicity thereabouts, that it was due to some form of steam explosion; though just what form or how it occurred they never suggested. About the latter date, other similar craters were discovered. The first was near a place called Odessa in Texas: the next near one named Dalgaranga in Western Australia; then, the place where

something enormous had landed out of the sky in Siberia in 1908, destroying hundreds of square miles of spruce forest and rocking a railroad train to a stop over fifty miles away, was investigated. Since that time several dozen more such craters have been found. The largest is in Ghana and is over six miles in diameter. The second biggest is the famous Chubb Crater in the Ungava Peninsula of upper northwest Quebec, that is 11,000 feet in diameter; the third biggest is the original Arizona Crater now named the Barringer; and the fourth, one at Wolf Creek in Northwest Australia.

After the discovery of the Chubb Crater, the Canadian Geological Survey re-examined its detailed aerial surveys and brought to light dozens more scattered all over its territories. Some of these were spotted only because different vegetation grew upon their rims, on what had once been their outer slopes, and within their rims, while some of them still contained circular lakes, or bits of circular lakes, outlining those rims. Technicians searched out these ancient meteorite craters, and by drilling and electronic sounding, made a remarkable discovery that sets at nought a great deal of the general theorizing about comets, meteors. and meteorites. This was that the bodies that caused some of them landed as long ago as Silurian times--400 million years ago--since deposits of more recent date had been laid down over them, completely filling them in, and covering them. The existence of these craters today is only observable because these overlying strata have been denuded down to the original level. This, however, is part of another story. The important fact about these great craters, from our particular point of view at this moment, is as follows: -

Once it had been admitted that they were produced by large meteorites smacking into the surface of our earth. people began to dig and probe for said meteorites. Since the body that caused the Arizona Crater was estimated to have weighed a million tons and, from bits and pieces found scattered all around the crater, to have been of the nickel-iron type (meteorites are of four types: nickel-iron, stone with included iron, stone, and glass) it was supposed that some [AD] $300,000.000 worth of almost pure metal alloy was buried somewhere below this hole in the ground. A mining engineer named Barringer spent half a lifetime. very considerable sums of money, and tremendous effort on a valiant but, as it now turns out,

misguided attempt to locate this monstrous treasure. The reason for the failure is simply this.
The body that caused this crater was of very great

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mass and it appears to have struck at high cosmic velocity and in one piece. As such, it more or less amounted to the famous "infinite mass meeting an immovable object"-the latter being the much bigger earth. When anything approaching such a condition occurs, the lesser of the two objects may be said to "hit" or strike the greater. When it does so. moreover, its lead-edge is almost infinitely compressed in the minimum space of time--which compression is just as instantly transferred backwards through its mass. At the same time the surface of the greater obiect that is hit is also instantly compressed. In fact, the total energy of motion of the lesser mass is "released" and. having to go somewhere but being unable to do so kinetically, it is converted into heat--but heat so great that it not only instantly vaporizes all solids, but may even (if the hitting mass is great enough and traveling fast enough) tear its molecules and even its atoms apart. The result is a bomb-like explosion that may be in part atomic and which takes place a fraction of a second after the lesser body has ploughed into the surface of the greater. This goes off in all directions at once, but since the greater body is less "movable" than the lesser is "irresistible" it causes a crater in the former while the latter is utterly shattered and the greater part of it is disseminated as fission products. gases, and liquids. Any solid bits left untouched, go backwards and outwards. Thus meteorites of more than a certain size (if they reach the surface rocks
Just before going to press. Ivan Sanderson informed us of a most remarkable discovery, a preliminary account of which appears in the current issue of The Nigerian Field (vol. XXVI, No. 1. Jan. 1961). The Journal of the Nigerian Field Society. West Africa. This in the form of a brief article by M.D.W. Jeffrevs Ph. D. entitled "Some West African Meteorites". This page and a quarter is packed with more new data on meteoritics, and more important data, than comparatively, any other paper of its size ever nublished. As it also contains several quotes from various sources and also credits these discoveries to still others, while it would be impossible to obtain permission to reprint it in full in any case and probably not just because of the

time factor. I asked Ivan Sanderson to compress the essentials and some comment into what space had available. The following is the story.

The largest meteorite crater so far discovered, far surpassing the great Chubb Crater of the Ungava Peninsula. Canada. is situated in Ghana West Africa. The largest individual meteorite recorded until this date lies in of the earth in one piece) just blow up, leaving only a dusting of bits scattered far and wide around their craters.

There comes then the interesting question. If you build a spaceship and want to avoid being punctured by meteorites--which you obviously do-you must increase your armature. But at what point does this increase amount to making your ship an "immovable object", and in relation to what sized "irresistible force"? The amount of sheer armour you wear on a spaceship is itself a moot point and a very difficult one because the power needed to lift it against the gravitic pull of our earth increases by alarming progression. The numerical incidence in space of solid bodies of various sizes is not known. Do vou therefore try to protect yourself against penetration by pea- melon- automobile- or ietplane-sized objects? This is the crucial question because collisions are going to be one of the greatest hazards in space flight, while just about the point where penetration can be stopped by armour. impact explosion begins. and we can't make our space ships completely solid like an earth. Here are all kinds of nice problem for the engineers to play around with, and all of them starting with the density of that particular alloy of iron and nickel that is the common constituent of the majority of the dark solid bodies that are buzzing about in what we call space. Flight through these is indeed. going to be a hazardous enterprise. Greenland being too large to be worthwhile retrieving. It is a strange coincidence therefore that a meteorite far surpassing that one in bulk, and thus becoming the largest known. should have also been found in West Africa Mr. Jeffreys in his article tells almost casually. the history of this discovery.

It appears that during World War II. Nigeria faced a very serious shortage of iron, and since local agriculture is wholly dependent upon the iron hoe the country was facing potential famine. It was however, recognized that there were some sources of iron on the eastern borders of the country and in the British Cameroons beyond and the government dispatched Jeffreys to investigate these. The center

of the area is named the Bamenda Plateau.
It so happens that I myself visited that country on a zoological expedition in the early 1930's and discovered quite by chance in the adjacent Assumbo area ancient iron mines and ironworks, and in one of the former an Ancient Egyptian bronze ushabti figurine. This went far to confirming the most ancient tradition that the trade route across the Sahara from Lower Egypt to northern Nigeria, of which the Romans spoke was, as has several times

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been stated, primarily for the conveyance of crude iron to the former. This is all remarkable enough but what Mr. Jeffreys discovered was something much more astonishing.
He says that the Chief of a place named Mbebji in Nkambe Division led him to "a huge mass with a number of large fragments lying around". From this he managed to knock off a few pieces with a very heavy hammer. One of these samples he sent to the Geological Survey at Kaduna. This appears to have been the year 1940, for he remarks that thirteen years later he published an illustrated article on this in Man, vol. LV.. Nov. 1953, entitled "A Bamenda Meteorite," for the Geological Survey had reported that the material submitted was meteoritic.
The article goes on to quote an enquiry from Professor Lincoln La Paz, Director of the Institute of Meteorities, University of New Mexico, the leading world authority, in which he states that, if this is sufficiently confirmed, the Bamenda Meteorite will be by far the biggest so far found. Mr. Jeffreys tells us that he revisited the mass, obtained more samples, and submitted these to the Senior Geologist of the Geological Survey at Buea, South Cameroon. This expert. Mr. Casey, replied that it was quite certainly a portion of a meteorite".
The most intriguing part of this story is that this mass had apparently been a recognized source of ore for the local native foundries for some time. Just how long a time one would like to know; and just how much of the mass did these "miners" manage
10 disengage and export to those foundries.

AMONG OUR CONTRIBUTORS

There is no need to introduce ISAAC ASIMOV, HANNES BOK and LESTER DEL REY to any reader of this Journal. There should be no need, at any rate! In their several approaches to the field,

they are each representative of the many facets (I almost, with equal accuracy, spelled that faces!) of science fiction! Isaac Asimov is, of course, the inimitable authority on robotic law. Hannes Bok remains, as always, a joy and a delight to the many among us who respect him for his many contributions to the field. And Lester del Rey is of course the author of ROCKETS THROUGH SPACE, ROBOTS AND CHALLENGINGS, NERVES, etc.. and of a number of articles I was happy to publish when I edited Fantastic Universe!
WENZELL BROWN is the author of more than twenty novels about contemporary matters.
MAJOR GEORGE FIELDING ELIOT, the distinguished military analyst and historian, discusses with considerable authority problems which we face right this minute.
Then again, there are not, as far as I was able to ascertain when I visited that country, or have been able to discover since, any ore beds reported from the area. Yet, iron workings have proceeded there for centuries, perhaps millenia. Those pointed out to us in Assumbo as being "place where man dig for iron", with an implication of long ago, were exceedingly odd being obviously artificial caves dug into the west sides only of some mountain ranges about halfway up their steep slopes. (There are no natural caves thereabouts). These holes were about fifty feet wide and went down variously to between fifty and about two hundred feet at a forty-five degree angle into the hillsides and then all stopped abruptly. Outside their entrances were large artificial scrces resultant from the tailings.
At that time. I accepted the local peoples' statement that they were iron diggings, and while I never located any iron ores, I assumed that it was for these that the diggings had been made.
It has now occurred to me that a great swarin of very large meteorites might have landed there in ancient times, coming in from the west on a 45-degree trajectory. The earliest iron artefacts known seem to have been derived from meteoritic iron, rather than from ore. There has always been a lingering suggestion that the earliest iron implements came from West Africa. Could the first and major source of iron there have been meteoritic and still in part be so as new meteorites or bits of them are found?
The Assumbo diggings were not for ore.
IVAN T. SANDERSON, the noted scientist and lecturer, is the author of numerous books including THE MONKEY KINGDOM (Hanover House)

and the forthcoming THE ABOMINABLE SNOW-MAN (Chilton) and THE CONTINENT WE LIVE ON (Random House). Readers of Fantastic Universe (forgive me for mentioning the magazine again!) will remember his articles for that magazine on the Abominable Snowman. His book for Chilton will incorporate considerable new material.
We are indebted to the Press Department of the Embassy of the Union of Soviet Socialist Republics, in Washington, for the articles by V. BELOUSOV, ALEXANDER MIKHAILOV. and V. CHEREDNICHENKO.
May I take this opportunity of also thanking Y. N. IBN AHARON for his assistance in getting this issue out to you when we were forced to change printers in mid-stream. As a friend of mine would put it, it was a most distressing situation.
H.S.S.

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PUBLICATION: JOURNAL OF THE INTERPLANETARY EXPLORATION SOCIETY
DATE: JULY 1961, VOLUME 1, NUMBER 2, PRICE: $1.25
ARTICLE: SPACE HAZARDS
AUTHOR: IVAN T. SANDERSON
PAGES: 18-25

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Life?
by
Terence Roberts
Some call it science, some science-fiction, others mere fiction. Then, of course, we are today getting a bit chichi so that there are still others who might prefer to call it philosophy, metaphysics, mind-science; or mysticism, zen-buddhism, yahoo, or what-have-yoo. But whatever you want to call it or do call it, you've got it; and, apparently, its here to stay; at least for a little while yet. But what is it? Nobody has the slightest idea; not even the ministers of religion. Let me give you a case in point and a problem.
nesses
We now know, and can demonstrate, that there are certain items of particularly small size called ultra-filtrable viruses (a nice expression) and bacteriophages (an even better one) the second of which "phage" or pursue and molest bacteria just as bacteria molest us. Some of these infinitetesmall-(and that's even better), it is now also

known, spend some time as living organic entities, moving about, phaging bacteria, breeding in sundry rather odd ways, and generally behaving like what we call "living things". But at other times, they sort of get fed up with it all and, instead of just going off to Europe or some such, have the audacity to crystallize. And this means sort of turn into a bit of what we call "inineral" with proper crystalline faces and all. Then, they are not, at least apparently, "living" at all, or in any way.

Lots of very funny and rather complex things have to happen in order to bring these crystalline bits and pieces out of their crystallinity and make them go back to phaging things and breeding. Yet just such things do happen and with singular regularity. And so it goes.

Now what, I ask you believers in life, do you make of this? Are these things alive or not? And. if they are when you say they are, or are not, when you say they are not, what is the difference, and what happens to them when they are not? Is this

much vaunted "life-force" (which, I can only presume, makes the sole difference between a living thing and a non-living thing) inherent in the mere substance of which the entity is made, or is it outside it and not physically of it? If so, where does it go when the "bit" is being difficult, or being a crystalline entity? It's up to you to say.

But this sort of obnoxiousness is not unique to minutiae like bacteriophages. It happens all over Quite a number of plants have an at first alarming habit of drying up and lying as if dead - whateve that they may mean-for days, weeks, months, years, or even for centuries. Somebody dredged some lotus seeds from an extremely ancient grave in China; planted them, watered them; and they flowered. But that may be another thing, for plants have a durability that is frankly incredible. They grew wheat taken from a pot in an Ancient Egyptian tomb to find out what breed it was. Very dull: it proved to be identical to the lowest-grade wheat found in peasant Egypt today!

But the point is that plants are "made" to dessicate and wait out the centuries or man's pleasure. Sometimes also, they only appear to relive. The best examples of this are the now famous Resurrection Plants, one of which you can buy in tourist junk shops out west. These are, first, the Rose of Jericho, which is native to Egypt, Arabia, and Persia that, after its seeds mature, drops its leaves and curls in upon itself and dies. Put in water, it opens

out, gets green and appears to live again. The second is the lowly Selaginella found in Texas which dries up into an unpleasant-looking ball but which can then be made to open out and grow with mere water. The third is a fern that grows on other trees in Florida and which does the same. But these plants just sham death. They never really give up life until something happens. We don't know quite what; but sooner or later they, like all other plants

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do die. It is not so with certain true animals.
The huge group of higher animals to which the spiders belong contains eleven great orders of, animals, in addition to the spiders. Among these arc the Horseshoe-Crabs, the Scorpions. the Daddy-Long-Legs, and the Ticks, and the Mites. It also contains a small (vis-a-vis known kinds) group of rather complex animals of minute size called the Tardigrades that are possibly and quite probably the most numerous, in actual numbers of individuals. of all animals that breathe air. You can, but probably will not, find them under any bit of moss or dead leaf anywhere in the world from the north of Greenland to and upon the Antarctic and from under the sea to the tops of the highest mountains. They average from about one-third to one millimeter in length.
These little things have three or four pairs of jointed legs terminating in hooks. and most of the junk that we have inside us like such essentials as a nervous system, a blood system, a stomach and alimentary canal, liver, reproductive organs and so forth. They are not, I would emphasize and despite their normally rather small size, primitive things like amoebae. They are of the spider variety; and spiders in some respects surpass us-in geometrical web-construction for instance. Now, these Tardgrades have several odd customs but one that is really profound and inexplicable.
If you take some moss from a bog in, say, your back yard; soak it for a number of hours and then waggle it about energetically: gather the dirty stuff from the bottom; put it in a centrifuge; and then take a look at the middle of the mess, you will assuredly see a lot of Tardigrades under even a low-powered microscope. Get these out into a small watch-glass. put them back under a microscope and then watch them as the light-heat evaporates the water. They will dry up into minute scraps of crystalline dust. Touch one of these with the tip of a

badger's hair and it will fall apart. Under a high power you may then see that each of the bits is

NEXT ISSUE!

nothing but "mineral"-crystals of various salts and assorted amorphous junk.

Now take the bits of dust that you have not broken up and put them carefully away under a bell-jar in sterile air, and evacuate all of that air that you can Seal the lot, and store for a year; two, three or ten years; or whatever you wish. Then take the watch-glass out carefully. put it under a micro-scope: get the dust in focus; apply water from a pippet, and watch.

In no time at all the bits of dust will swell up and assume exactly the form and proportions of the little animals from which it was derived so long ago. But wait!

In about half an hour you will also see, and pos-sibly to your amazement if you have a philosophical turn of mind, that the resurrected animal-form is beginning to move. It moves. it scrambles about, it positively struggles. So give it a bit of moss to crawl into-sterilized moss, mark you-and wait a few days, watching the while; and what you will see really should upset you, for the little beasts start to breed.

Now what, I am asking you, is this?

When the Tardigrades dried up, did they die? If not what happened to that part of them that (we presume) was not purely material or physical? Did it stay in the crystalline salts that formed out of its body fluids, or in the amorphous junk that was left with it? Did it go off somewhere else and wait patiently for you to give the bit of dust some water? Did it hover nearby? If so where; and are you speaking cosmically or atmospherically? After all, you insist that there is a difference between an ani-mate and an inamimate object-i.e between a Tardi-grade and a Stone. So what is the difference? You tell me, please.

If the "animate" part has the volition. lowly as it may be, why does it wait for me to give it water? Or is it water? If not, what is it? In fact, is it? (I'm running out!) Is it? It?

???

Some call it science, some call it science-fiction, others call it mere fiction. But there it is.

ARTICLES by LESTER DEL REY and IVAN T. SANDERSON

plus

A STARTLING NEW ANALYSIS OF THE DEAN DRIVE

and

CARTOONS AND STILL MORE CHALLENGING ARTICLES

In

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PUBLICATION: JOURNAL OF THE INTERPLANETARY EXPLORATION SOCIETY
DATE: DECEMBER 1960, VOLUME 1, NUMBER 1, PRICE: $1.25
ARTICLE: LIFE?
AUTHOR: TERENCE ROBERTS (pen-name of IVAN T. SANDERSON)
PAGES: 14-15

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THE EDITOR SPEAKS

By the time this first issue reaches you, things will have quieted down and we will have time once more. to turn our attention to the reality that, whether we like this or not, Soviet Space advances do impress World Opinion! The election-time need having passed for statements made with one eye on wavering voters we may perhaps face this reality and realize that, the late Dr. Coue to the contrary, it is not enough to repeat and repeat and repeat, until we at least convince ourselves, that all is wonderfully well with the world around us.

Unfortunately it isn't...

In a world in which, technological advances to the contrary. "poverty is by and large getting worse and worse all over the earth"-a world in which "we are intent on abolishing poverty, giving everybody a high standard of living, even if we have to blow the place up in order to get rid of poverty... maybe we will end up with a high standard of dying," (to quote Thomas Merton in Jubilee for October 1960). realism is doubly necessary if we are to survive as a race.

And as a planet

A United States Information Agency Office of Research and Analysis report, under date of October 10, 1960, apparently shares John Kennedy's concern at the reality that "public opinion in most parts of the free world believes that the Soviet Union is ahead of the U.S. in space achievements. There is also belief that the U.S.S.R. will lead in space ten years from now." The same report, discussing trends derived from available data, comes to the following conclusions:

"Space achievements will probably continue to be viewed as essentially military in their immediate implications. The linkage of space with military applications in the public mind seems likely to make

it a continuing important ingredient in popular estimates of national military power.

"There appears to be, as a corollary to the above, a growing body of expressed concern over the dangers of an unchecked space race, which is seen as giving new or increased menace and dimensions to warfare. International agreements and controls to check these dangers and to assure that space is used for peaceful purposes only, appear to be increasingly an aspect of world comment on space developments.

"Belief that the U. S. and the U. S. S. R. are in a space competition seems certain to persist, and both sides are viewed as committed to rivalry in space.

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INTERPLANETARY EXPLORATION
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THE JOURNAL OF THE INTERPLANETARY EXPLORATION SOCIETY, Vol. 1, No. 1. Published quarterly by the Interplanetary Exploration Society, 37 Wall Street, New York 5, and edited by Hans Stefan Santesson. Office of the Editor-489 Fifth Avenue, New York 17. No responsibility for unsolicited submissions can be assumed by either Editor or Publisher. Reproduction of contents in whole or in part, except for purposes of review, strictly forbidden.

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Actually, this love of knowledge spurs us all. Curiosity-the urge to explore the universe-that is basic with all humans, especially human bookworms, as we seem to be.

We don't know how big we can grow, but we do know that we exercise a function which meets a felt need. Public relations are good, for the little distance we have reached. Concurrence is strong that there is a valid place for speculative thinking in the total process called the scientific method. No publication exists for it; no scientific journal dares meddle with guesswork. What if they were to crack a joke, be taken seriously, and blow up the country?

An odd thing about the scientific method is that unless you already think that way, no amount of explanation will convey it to you. It seems to be something like explaining a joke the more you spell it out, the sadder it gets. Well-educated people are often quite confused about it. They take courses, they work at things requiring knowledge of scientifically-acquired information, but the place of observation, guesswork, experiment-followed by corroboration equally valued with disproof depending on whichever comes up-to some people this is utter frivolity.

Queerer still they are right; and we are right only if we are in this for the fun of it. And so we are.

And hope you see the point.

The Editor Speaks

(Continued from page 1)

"The multiplication of marvels seems to have both educated and jaded public appetites. There is also emerging, although still somewhat tenuously, some recognition in public comment of a difference in the scientific productivity and refinement of the U.S. as against Soviet space programs, and a belief that the U.S. has been more candid in admitting failure, and more open in making the results of its experiments available.'

With the above in mind, there is obvious need for a journal of opinion, not politically orientated or so one-sided in the approach that sight is lost of the need for occasional laughter, aimed at readers who share our interest in speculative thinking, in the exploring of new ideas-whether or not history will prove to justify them.... Aware of this, the Boston group, feeling that Interplanetary Exploration Society is perhaps a shade too ambitious a name, solemnly considered alternate names at their September meeting such as "Chowder, Marching and Argument Society", "American Society for Speculative Research" (Ah! This I like!), and-last but not least "American Society for the Encouragement and Preservation of the Consideration of Unproven Hypotheses".

Be the final voting what it may, we come to you with this first issue, with contributions by Poul Anderson, Lester del Rey, Academician N. M. Sisakyan, Father Daniel Raible, Professor Rom Landau, James E. Gunn, Hannes Bok and others. This Journal, if-with your help-we continue beyond the second issue-will carry increasingly challenging material by John Campbell, Lester del Rey, Dr. Ivan T. Sanderson and others, material which may raise the possibility that the moon as a missile platform is in the Flash Gordon class, and that many of the proposed military uses of satellites and moon voyages are simply silly, as Lee DuBridge, President of the California Institute of Technology, points out in his recent book, INTRODUCTION TO SPACE.

age...

In other words, this Journal will, deliberately so, explore ideas and proposals and problems and realities of what, prematurely so, is called the space

This is going to be your magazine! With your help we will grow, from this issue's 32 pages to considerably more! To do this we need articles from you out there-challenging, stimulating and even controversial articles-and we need subscriptions. Many of them!

There is need for a journal of opinion in this field!

H. S. S.

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Correspondence
by
Alma Hill

The other officers of this Society are well-known people, but few of you know me, so I'll begin by introducing myself. I am a knot-headed old schoolteacher with a background divided between science and humanities. I teach reading and writing - word work in secondary school classes, and if you stop to think about it, you have to like knowledge in order to like word work.

But there is a difference, as I see it, between the wide-focus knowledge that words are mainly used for, and the specific closely-measured meanings that scientific language is used for. I am a down-to-earth sort of person, as most women are, and am therefore inclined to prefer scientific knowledge because it is in its nature more communicable and more usable.

My job on this project is to run the club bulletin and answer the mail. It is more fun than most people ever get a chance at, believe me. The people I've been hearing from are imaginative, critical, skeptical, realistic, and have a wonderful sense of the ridiculous. I don't know what all we are going to do, but whatever it is, I'll be helping all I can in order to see all I can.

This association actually began in the Press Box in New York, a little before Sputnik went up, if you can remember all those aeons back, there was something slightly absurd about the idea of space travel, as most people saw it then. The founding members chose this title because they were perfectly well aware that this joke had a last laugh, as later appeared. The title implied a curiosity about everything, and this is still the spirit of this project.

The founder, F. Darius Benham, has since died; but two of the founding members, Michael R. Todd and Walter B. ("The Shadow") Gibson, are on the present committee of officers. Other founding members include Arthur Gray, John Campbell, and Leo Margulies, all of whom expressed to me a strong continuing interest, and by various actions showed that they meant it.

Meetings were also held in the Hayden Planetarium, the New York Museum of Natural History, and some branch library space. These might be going yet if the central group had not been oversophisticated about their plans for publication. They asked for 3000 subscriptions to carry a journal on the general plan of the National Geographic Society, but leaning more to all sorts of new ideas in speculative scientific thinking. In fact, over 500 [AD] subscriptions came in at once, but these funds allowed nothing for running the central communications or advertising the idea. It looked like all tail and no kite, hard to get off the ground.
money
Finally, however, the whole thing was reorganized by giving the subscribers the option of having their back or whatever publication the total funds, about $3000, could be stretched to cover. As this is written, five refunds have been paid and about thirty new members obtained in the thirty days we allowed to find out what the response would be. Many wrote with enthusiastic moral support, and several added more money. No large sums have been found and will have to be, if more than two issues of the journal are to appear. But we do seem to have good will and good people, which means that the future is full of hope.
John Campbell's company being forced out of the picture by its own commitments, we were fortunate enough to obtain the editorial services of Hans Stefan Santesson. The fourth officer in the present reorganization is the undersigned, a hardheaded old schoolteacher with a powerful affection for knowledge.
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TH. BEZE
EMBLEMATA.
Plena Luna Soli aduerfa. XXXVI.
Apud larobum Stor.
15 98.
Luna Soli oppofita,& interie&tu terræ
deficiens. XXXVII.
F Raternis Lund Stradins aduerfa refulgens,
corufcat
Sic Chrifti obiectos fpectans Ecclefia ulios,
Splendore lucet integra.
Lunu Soli fubie&ta,lumen illius terris
eripiens. XXXVIII.
L

Vnam interueniens ceu terra corpus opaci,
Atra inficit caligine.
Sic interueniens hominum fapientia,purum
Ecclefiainfufcat inbar.
L'
Vna velut fratri propius coniuncta, periffe
Stultis &idetur fundites,
Que tamen admoti fpectans tunc lumina Solis,
Ipfe refulget clarior.
Sic periffe pi vulgo qui morte videntur,
Abfit periffe dixerim,
Ipfo qui potius Chrifto propiore potiti,
Quod quafierunt obtinent.

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Space and Size
by Gunnar Höglund

It is getting to be rather a nuisance having small fry running about enveloped in plastics, brandishing instruments that burp to indicate selective annihilation. So far the activity is harmless, while young ones should be hellions. The business is going to get serious, however, when these small ones grow a bit bigger and start launching beer-kegs by igniting black powder in lieu of rockets, or reducing parental garages or basements with simulated atomic explosions. The first atomic explosion went off only fifteen years ago, and the first space vehicle went up just three years ago. The small fry launched at the same times are therefore still only modest teenagers or mere infants. Quite soon, therefore, the former are going to be running things, and the latter....but only God knows what they will be doing.

Perhaps it may thus be pertinent to enquire just what the people who are allegedly now running things are really up to. There is no harm in asking this question though there is practically no likelihood of it being answered. Security is only half the reason for this. Plain lack of knowledge accounts for much of it, while prevarication, divarication, and just plain mendacity play a not inconsiderable part in this "conspiracy of silence." Some indication of the way in which things may be going can be judged by the way everybody including the absolutely top chaps, such as Dr. Wernher von Braun, among others -- talks about space. According to all and sundry, it appears that everything, everywhere, "above" or "outside" the range of airplanes is a place called "Outer Space". Even

balloons that have gotten above planes are glibly stated on occasion to have made "space flights". This is nonsense, as I shall point out.

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Only a short time ago space was just an irksome unreality: in fact, nobody was quite prepared to say whether it even existed per se or was merely the opposite of something. They are, however, still wrangling over what something really is, but that is another matter -- and no pun intended. Now, all of a sudden, everybody talks glibly about the former, while all the nice old definitions, valid or not, have been tossed in the ashcan of semantics or just bulldozed into oblivion. In no time at all, everybody has seemingly become on a first-name basis with this elusive nothingness they call space, and talks about it with great intimacy. The trouble is not only that they are talking about something of which they know nothing, but that they don't even name it properly.

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and

The thing that I most object to is the misnaming of things. I don't mind anybody coining a new word and I don't mind how many languages there are, though having more than one for one species of sentient animal is manifestly idiotic and an invitation to trouble; but I do object to the name of one thing being used to denote something quite else. The Haitians call a kind of banana a pomme-figue or "apple-fig". This is puerile enough, but when you show them a fig, they call it un frais to wit, a strawberry. Such double-talk leads to muddled thinking and, as a fairly famous British socialist minister once remarked in Parliament thereby brought that august body to a thundering halt -- "Words should convey meaning". Therefore we have got to define what we mean by the word 'space' and, what is much more important, learn to differentiate between Inner Space and Outer Space. To begin with, almost everything is space, while there is so much matter be that, itself mostly space in what we call Space, that any distinction made between what we do not call space, or what we call not-space, must be purely arbitrary. The old idea was that space began where matter case of our planet, its atmosphere -- gave out. However, this point -- or rather, ill-defined surface -- has been repeatedly pushed outwards, while, year by year, so much more matter is identified in the 'space' beyond, that the distinction between the two is becoming blurred to the point of ex-

tinction. Meantime, also, balloons and planes are flying higher and higher and rockets higher still, while all manner of rubbish has now been shot right off this earth in various directions. At what point then does space begin, who says so, and, how many other people agree? At the moment there are no answers to these questions.
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in the
Then again, there is the much more troublesome concept of "Outer space". For this, as opposed to "inner space", there is a definition, but nobody and not even the blokes who are allegedly, as they say, probing it, seems ever to make a proper distinction between the two. Outer Space starts beyond the sphere of Inner Space which extends from our sun in all directions to the point which is equivalent to the radius of the orbit of its most distant planet. Thus, the assorted rubbish that has been projected completely out of the earth's gravitational

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influence
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though theoretically you can't get away from that, even at infinity is all, as of now at least, messing about in Inner, not Outer Space, as more or less everybody, from the President to the kid on the corner, and the good Herr Professor Baron von Braun included, according to some of his statements to the press, would lead us to believe. These are two very different things in point of time as well as space, even if they are intrinsically of similar composition and properties, or lack of them. While few yet appreciate the difference between outer and inner space, almost everybody thinks he knows the difference between inner space and the Upper Atmosphere; though he is usually hard put to it to differentiate the latter from the Lower Atmosphere. However, practically nobody appreciates the differences between these differences. Meanwhile, countless drawings, diagrams, and other visual explanatory material is being churned out in ever-increasing volume that makes the whole universe look from our point of view like a cosmic onion with the earth in the middle, surrounded by a number of skins. In some respects we are in fact heading back into the old terracentric point of view. The trouble

is not only with the standard sizes of paper on which a very limited amount of everything can be shown if anything in particular is going to be depicted large enough to be seen, but is with out complete incapacity to conceive of or understand size.

Quite naturally we used to, until recently, regard everything in our own light, as it were. Until the invention of the microscope and the telescope, we assumed that we were of normal size, while the biggest thing was the earth and the smallest was something called a mote, which could just be detected in a shaft of bright sunlight but about the substantiality of which there was prolonged debate. The invention of either the microscope or the telescope alone might have jolted man out of his assurance about his normality but, coming together, they only further assured him of it, for it seemed that the farther "down" or "up" you looked the smaller or bigger things became, while we appeared to remain right in the middle. This notion has in large measure persisted but we have completely lost control of our senses as regards the degree of bigness or littleness of things. We never were much good at the numbers game, having until comparatively recently been unable to count at all or until even more recently assess any number greater than that of our fingers. A lot of people still count: "one, two, three, four, five, six, seven, many, many-many, lots, like grains of sand on the beach, like the stars, I don't know," and few of us still can actually differentiate between five-hundred and a thousand of anything by mere sight, as may be quickly appreciated by a survey of the estimates by politicians of the crowds attending their incantations.

Since the institution of so-called civilization figures have been going up and down steadily and by geometric progression. Even the Greeks had started to count in the billions and the early Christians were as intent upon how many time the head of a pin could be divided in order to accommodate all the angels as they were upon ascertaining whether Christ had a navel or not. Then there were

the mathematicians who played with numbers just for fun. Today, the whole business has gotten completely out of hand. Take, for instance, the budget, or better still, the national debt. Who among us.can really conceive of the latter, or of a few trillions of anything. When you come to contemplate a light-year, even the attempt would be a waste of time, and all we can do is rely on symbols and glib talk like how to deep-freeze a "space-pilot" so that he can

get to the nearest star. Any real idea of the size of such an undertaking is quite beyond us, and apparently even of some of the "space-probers". Is there, then, any way in which we can express the size of things, either actually or relatively, that can make any sense?

This is, after all, a rather important question for we no longer know where we are, and are very rapidly losing sight of ourselves. Are there, in fact, more "bigger things than us" than there are "smaller", and do the former go on getting more bigger than the latter do smaller? Is there any end to either bigness or smallness and, if so, how far off is each from us? Are we, in fact, big or small?

Now, there are two things we can take as starting and stopping points. These are: in littleness, a single electron, and in bigness, the Universe. Division of the electron or an electron is theoretically possible, since you can cut anything that exists in half or into an infinity of smaller pieces but if you start chopping up an electron it appears that you get something literally "out of this world"
meaning
outside our concept, our logic, and our particular space-time continuum. The Universe, on the other hand, apparently has (according to Einstein and others) a definite limit, even if that be at infinity.

If you try doubling the universe you will get two universes alright, but both in exactly the same place and time so the mathematical procedure is not worth the candle. Thus, we may with fair satisfaction say that a single electron is the smallest thing available and the universe the largest. Comes then the question, How much "smaller" and "larger" are they, and then what? In other words, how big is an electron and how many times bigger than that is the universe?

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Happily, Professor Einstein, after setting up some impossible questions, was pleased to give us some concrete answers. One of these was that the Universe is 1,000,000,000

ascertained by a ruler or a pair of calipers. You can't, however, measure an electron by such means,
or by any other for that matter not only because it is too small but because it doesn't have any length or breadth. It is thus the proverbial point but it does still have a definite size, and its "size" may therefore be expressed as what is called mass.
Taking, then, a single electron as unit mass, how

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big are other things -- all of which must be bigger

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such as us, or the earth, or the sun? In other words, how many "points" of the "size" or mass of an electron are there in an average man? This is not, of course, the same thing as asking how many electrons there are in an average man, for this depends on his density the number of atoms per unit of space.
There are different numbers of
atoms in various substances, and as all of them are at great distances from each other, even the densest of matter is mostly space. Electrons are now, moreover, conceived of as sort of clouds gathered around atomic nuclei.
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even
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Here we are speaking of actual size, and merely using the size of an electron as a unit of measurement, expressed as mass, so that we may make comparisons with other objects of known greater mass. Since, however, the figures for almost anything
a single atom, or the simplest
molecule will, as a result, be so great, we must first design some handlable method by which to express our findings. This can be provided by a sort of ladder-like chart as shown herewith, marked off into 87 sections or rungs. On this, we write "1" on the bottom rung and "87" on the top, and put against the first "An Electron" and against the last "The Universe". For further convenience we may then draw a dotted or heavy line across the ladder between numbers 43 and 44 to indicate the halfway mark, and two others between numbers 22 and 23, and 66 and 67 to show the quarter and three-quarter way points. Each rung on this ladder will then indicate a tenfold in-

crease in the mass of the object on the rung below. We now proceed to enquire into the size of various objects, and for this we may turn first to the physicists and chemists.

From these precise folk we learn that an atom of hydrogen is 100,000 times the size of an electron, and that a molecule of water is on the next rung up our scale, or ten times larger than that. The next six rungs (that is, numbers 8 to 13) are occupied by various other types of molecules, the largest being on the 13th rung and thus a million times larger than a molecule of water. This is a surprising spread in size for things we normally think of as being almost as small as one can get. The largest known molecules are those of certain compounds of hydrocarbons, and the amazing thing is that some of these are larger than the smallest living things; and it is here that we could start running into difficulties, for we no longer have any precise way of distinguishing living entities from non-living ones,' or what are popularly called inanimate objects. This is another story, and will not further concern us here but to say that certain entities which behave like living entities or as animate objects may be composed of as few as only four giant molecules, while single molecules of some of these substances themselves behave very much like live things. There are also very minute entities called Bacteriophages, which parasitize bacteria sort of bacteria squared, or diseases of bacteria that are extremely minute and which spend part of their existence as living entities and the other part as crystalline structures. The dividing line between

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animate and inanimate is thus a very blurred one; but we may take it (at least for this planet and as far as we have so far been able to discover) to rest upon the 13th rung of our ladder of size.

Before proceeding to further investigate the size of other life forms we may profitably turn to the astronomers for answers to a few basic questions at the other end of the scale. In their field, there are two figures we would particularly like to obtain. These are, the size of the Earth, and of the Sun. And, here, we get a considerable surprise, for it transpires that these are situated upon the 56th and 62nd rungs respectively.

These facts I personally find to be so startling that I have never been able to bring myself quite to believe them. Of course, the farther one goes up our ladder the greater the actual differences in size between objects on adjacent rungs becomes. For

instance, 103 is 1000 and 104 is 10,000, a real différence of 9,000 units, whereas the difference between 1020 and 1021 is 100,000,000,000,000,000,000 units. Nevertheless, from the findings of modern astronomy one has gained the impression that even our modest galaxy is a pretty puny item among the seemingly endless galaxies of galaxies, and vis-a-vis the universe itself. That the Earth should be five-eighths of the way up the ladder and our very meager Sun more nearly three-quarters of the way up, somehow seems marvelous. Perhaps, therefore, we may truthfully regard our solar system and our particular planet as being not quite so unutterably unimportant after all. What is more, these facts or figures begin to give us a better understanding of size and thus perhaps of space.

Already we can see, by means of photography, if not by the human eye aided by mechanisms, all the way down to about the 10th rung of our ladder; and in the other direction, it has recently been announced, to a distance of some hundreds of billions of light-years away, which represents a globe of space that would sit on the 80th rung. This is almost as far "upward" as the super-microscopes go "downwards". Sight of a single atom is now promised soon, while new types of telescopes may one day actually show the "curvature" of the Universe -- in other words be able to look right around the whole of reality, as it were.

These physical facts go somewhat towards re-orientating us and telling us where we stand, in fact as opposed to fancy, but they do little towards correcting our psychological and emotional misunderstanding of our own personal position in the order of things, or the goals to which we are now aspiring. And, being sentient beings
that is,
creatures who appreciate the fact of their own existence this remains the key to our understanding of the universe. It is here that we must turn to the biologists and receive both our greatest surprises and some rather unusual boosts to our collective egos.

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Living things, as we know them, appear to have a universal bottom size-limit due to purely mechanical reasons -- to wit that, as we have seen, what we call self-animation seems to need at least one molecule to function as such. The existence of such

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super-molecules can, moreover, be envisioned all over the universe and under a fairly diverse set of physical environments
-- a set, moreover, that is
much wider in possibility than the average chemist, physicist, or especially astronomer, believes. These specialists are all caught in a sort of terra-centric box and are seemingly incapable of understanding the possibilities of cosmobiology, or even astrobiology. That is to say, they keep harping on the completely untenable belief that "life" can exist only on a hydrocarbon basis, and between the temperatures represented by 0 and 100 degrees Centigrade; whereas it could, of course, be crystalline or even gaseous, based on any forms or combinations of matter, and exist at any temperatures from a little above absolute zero (-273° Centigrade) to temperatures found at the centers of some dense stars.
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The upper size limit of life, as we know it, is
also apparently laid down by Nature, and again on purely physical grounds. These are limits of size; in other words, the limits of the size of things made of certain substances (such as flesh and bone), under certain gravitational forces in our case, that of this planet. Although ours is a small planet going round a modest sun, it has considerable gravity, so that anything on it above a certain size just collapses under its own weight. Strangely, the biggest things living on this planet are trees that stand straight up in the air and gain very little support by way of bouyancy from that medium. But trees are static and made of plastic (wood) which combines great strength with modest weight for unit mass. It turns out that the largest are some Douglas Firs growing in valleys at the heads of fjords in southern British Columbia; the largest of which, that has been ac-
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(the average)
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Largest Life-Form
Giant Redwood Tree
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Largest Animal

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Average Man
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Mean of Lifesize
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Smallest Animal
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Average Animal
Smallest Life-Form
Female Blue Whale, Largest Fish (Whale Shark)
Largest Land Animal (dinosaurs)
Largest Land Mammal (Baluchitherium), Shellfish
Largest Bird (Moa), Crocodile, Horse
Largest Flying Bird, Clam, Crab
Average Cat, Largest Frog and Worm
Average Pigeon and Rat
Mouse, Largest Insect and Spider
Smallest Mammal (Shrew) and Bird (Humming-Bird)
Smallest Fish, Average Bee
House-Fly, Smallest Backboned Animal (a Frog)
(Smallest Echinoderm)
Flea, Water-Flea (Daphnia)
Smallest Shellfish
Smallest Insect, The Human Ovum (eggcell)
Smallest Worm
(one quarter)
Amoeba
White blood Corpuscule
Red blood Corpuscule, Human Sperm, Monas
Anthrax (disease) Bacillus
Tuberculosis, Disease Cocci

Round Bacteria
Larger Viruses
Ultra-filterable Viruses
Largest Molecule
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11
10
16
16
7654321
Water Molecule
Hydrogen Atom
AN ELECTRON

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curately measured after felling, was 417 feet tall, 25 feet in diameter at three feet above the ground, and had a circumference of 77 feet. It was estimated to contain over 175,000 board feet of lumber.
The largest animal and therefore the largest mobile living entity -- so far known, was a female Blue Whale measuring 113-1/2 feet, and weighing 170 tons.
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The difference in size between these two objects, which stand on the 39th and 38th rungs of our ladder respectively, and the smallest known living thing on the 13th, is very great and represents more than a quarter of the total possible range of the sizes of everything. It is rather remarkable to think that such a vast range of size should be represented by living forms on our tiny cosmic speck of matter.
In fact, the largest is quite near the average, or middle rung, of everything.
Where, then, do we come into this scheme of things? The truth turns out to be that we are really very large as living things go, and are not even too paltry in the universe, for we are just about three-quarters of the way up the life scale, and only five rungs down from the largest. The average animal (that is to say, the mean average) is a housefly, six rungs below us, and the average of all life on this planet is just one rung below that. We are therefore a very large, though not a huge form of life for our planet, and we do hold a position not too far removed from our ancient concept of that position namely, somewhere in the middle of things.
Now, while we have probed almost equally far "down" as "up" in size, our future appears to lie almost wholly in the latter range, for nobody so far has suggested traveling physically "downwards",

though, it must be realized, such an idea is not
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THE UNIVERSE
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THE SUN
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THE EARTH
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(three-quarters)
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nearly so impossible or even science-fictionist as it may sound. Traveling, moreover, seems to be our business. As we said, the distances between the rungs as you go up are in one respect much more formidable obstacles to travel than are those going down this is to say in mere size because they represent so much greater actual distances. Thus, some real understanding of sizes greater than our own is absolutely essential if we are going to develop any real appreciation of what we are up against in space travel, and of what we may encounter when, if ever, we get anywhere in this super-sea of infinity.

The first thing we might do towards such an appreciation is to start being a little more careful about what we call what, and try to inculcate into the bemused minds of our younger generations at least the difference between the two layers of our atmosphere, and more especially between Inner and Outer Space. At the moment they seem to think that reaching the former is like discovering a new continent. Not a few even sincerely believe that we have already shot monkeys and mice into the latter when, actually, the former is equivalent to discovering 100,000,000,000,000 new continents, and to do the latter will take just that many times everything else -- even to get a small bit of steel into it.

ANOTHER EDITORIAL ASIDE

Reactions to the last issue were extremely interesting.

Spring Byington, out in Hollywood, called for "some real well thought out un-orthodox ideas on all the 'ologies', archaeology, sociology, anthropology, psychology, geology, etc. etc."

Our own Alma Hill, up in Boston, shook her head over some of the articles and felt, as had Miss Byington, that we had failed to realize not only the diverse interests of the I. E. S. membership, but also that there are so many problems, above and below the horizons which we know, which could properly concern a Journal such as this.

A number of people wrote that they found the issue "unique and very readable", but Phil Kohn, writing from Israel, referred to it as a "super-fanzine" and had some rather pointed remarks on the calibre of the material that had appeared in the first two issues,

(b)
"an article about how God might cheat
himself at solitaire, with intelligent races
as cards, if that was his pleasure, but why
should it be?";
"room for exhortations and self-praise
and self-mockery of amateur gentlemen
(what is a professional gentleman like ?).
If you mean gentlemen-amateurs, why not
say so-and why 'gentlemen' anyhow? Why
exclude Faraday, Curie-and me?";
(c) "room for anti-bomb propaganda whose
good intentions should grace the Readers'
Digest but are perfectly futile here, unless
you don't want to leave any space, you
person from Porlock.".
--
Man is a rather splendid experiment
-- for his
lack of imagination, if nothing else and his
achievements already are really remarkable,
though probably for the most part due to this lack
which is really an inherent strength rather than, as
commonly supposed, a weakness. Had he ever
stopped to take thought upon what he was attempting,
he would almost certainly still be contending with
the apes for food. Perhaps therefore, we should
not endeavour to disenchant or "disenlighten" those
little hellions in plastic suits with burping anni-
hilators. On the other hand, those grown-up hellions
who are already playing with the reality of the space
business might take another look at the real size of
the job they have undertaken, lest they and we all
bog down in it and collapse in face of its mere size.
We are going to need all the "gray" matter that we
can get and sooner than we know, and the only way to
foster the growth of this most valuable of substances
is to take to heart the maxim cited above, that
"Words should convey meaning." The universality
of Space is bad enough without our filling it with
mental vacuums, and muddling it with slipshod
semantics and just plain nonsense. Let us warn
the little space-suited people what they are going to
be up against in a few years.
(d)
"room for fantasies about superman to be
grown on Mars, based on the assumption
space transport will not improve for cen-
turies, and that the sun's energy falling on
space won't be exploited. Del Rey also as-
sumes that the government knows how to
pick superior minds, and that fish crawled

out of the water, looking for lebensraum. They didn't. The water left them behind, first for a time, then ever longer, and some of them survived.'";
(e) "room you have for discussion as to how many angles ought to be allowed in a needle's tip space law, when in fact there is no international law but only temporary agreements among powers trying to destroy each other without committing suicide at the same time."; and
(f) "the article on Venus has been in various science periodicals, with slight variations, since Herschel built his great telescope.'
(Mr. Kohn was referring here to the article on the Venus probe by V. Belousov, President of the International Union of Geodesy and Geophysics, which appeared in the last issue.)
Lack of space prevents my quoting Mr. Kohn's letter in full, including his suggestions for possible articles-admittedly more speculative in nature than what we had run when he wrote, but his reactions, and the reactions of others including the pained comments of Dr. Richard Eney in Speculative Review, were most welcome because they at least showed one thing-that we'd accomplished what we'd set out to do-that these people had read these articles and had very definite opinions on them.
And this, after all, was what we wanted.

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PUBLICATION: THE JOURNAL OF THE INTERPLANETARY EXPLORATION SOCIETY
DATE: DECEMBER 1961, VOLUME 1, NUMBER 3
ARTICLE: SPACE AND SIZE
AUTHOR: GUNNAR HOGLUND (pen name of IVAN T. SANDERSON)
PAGES: 13-18